

Preoperative anthropometric dysmorphology in sagittal synostosis. E.M. SALTER, The University of Texas at Dallas, and J.C. KOLAR, Columbia Craniofacial Center, Medical City Dallas.

Premature closure of the sagittal suture is the most common form of craniosynostosis, representing more than half of all clinically reported cases and most archeological specimens. Associated with this closure are numerous defects of the head and face.

To identify quantitatively the craniofacial dysmorphology associated with sagittal synostosis, 49 preoperative patients (40 males, 9 females) with a diagnosis of primary (non-syndromal) sagittal synostosis were examined using a battery of 24 anthropometric measurements from which 11 proportion indices were calculated. The measurements and proportions for each patient were compared to sex- and age-matched normal standards and converted to standard (Z) scores. The pooled data for each variable in the total sample were analyzed using a single-sample Student's t-test. The patients were then separated into two groups, less than 6 months of age (n=27) and 6 months and older (n=22), to examine age-related differences in measurements and proportions using a two-sample t-test.

The data indicate that the head is large and elongated with a widened anterior cranium and reduction in the height of vertex. The face is enlarged, particularly the vertical and sagittal dimensions. The head and face are significantly larger relative to the normal standards in children less than 6 months of age than they are in the older group. Restriction of cranial growth from premature suture closure results in compensatory transverse growth in the anterior cranium and increased vertical and sagittal facial growth.

Treponematoses in the prehistoric Caribbean, North Carolina coast and Kentucky: diagnostic considerations. M.K. SANDFORD, G. BOGDAN, G.E. KISSLING, University of North Carolina at Greensboro, Greensboro, NC 27412 and D.S. WEAVER, Wake Forest University, Winston-Salem, NC 27109.

In investigating such a highly variable condition as treponematoses, differential diagnosis, using standardized descriptive criteria is essential. We present bone inflammatory lesions from three prehistoric skeletal samples from the New World. The three samples are from the Tutu site (St. Thomas, USVI, AD 450-1450), the North Carolina coast (seven sites, AD 800-1500), and the Barrett site (Kentucky, 3000-1500 BC).

The samples were examined using Hackett's diagnostic criteria and the *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994). The type and distribution of skeletal lesions

differs between the three samples. The different samples demonstrate that Hackett's criteria and the new "Standards" have distinctive applicability with respect to the description and interpretation of bone inflammatory lesions.

The use of standardized terminology facilitates comparisons between samples. Also, the new "Standards" encourage consideration of underlying physiological processes. Although the use of standardized terminology clearly is important, it often may be necessary to use additional terminology for specific conditions, including treponematoses.

Which criteria should be chosen to define VO₂ max in non-Western children?
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VO₂ max is often used as a proxy to measure physical fitness. It measures the maximal consumption of oxygen per minute at a "maximal" heart rate. This describes how efficiently the pulmonary and cardiovascular systems of an individual work. An evaluation of a pilot study done in Bolivia on boys and girls (age 9 to 14) brought up to question how really VO₂ max was defined. A review of articles reveals that VO₂ max can be "operationalized" and accounted for in several different ways. It is, therefore, up to the scientist to decide the criteria he wants to choose to assess physical fitness. Among several criteria, maximal heart rate is the most problematic because "maximal heart rate" is particularly difficult to reach, at least in children in Bolivia. The pilot study showed that maximal heart rate varies quite dramatically between children, even though each child was encouraged to exercise as fast and as long as he could. It was quite hard to know if the child was willing to exercise at maximal heart rate or if the child even understood the concept of doing such an exercise. Therefore, it is difficult to know if the observed VO₂ max was the "real" VO₂ max or should have been adjusted by extrapolation to have some "predicted" VO₂ max at some predicted "maximal" heart rate.

In this paper, I will review the different criteria used to assess VO₂ max and will discuss the use of these criteria with children. I will extend this discussion by looking at non-Western children who may not be familiar with the equipment and whose culture might impede the measure itself.

Using simulation to detect potential effects of apparently minor social responses to an epidemic. L. SATTENSPIEL, A. MOBARRY, University of Missouri, Columbia, Missouri 65211, D.A. HERRING, McMaster University, Hamilton, Ontario L8S 4L9.

Analysis of weekly rates of travel among three Cree-Métis Aboriginal communities in central Manitoba during the 1918-19 influenza epidemic indicate that informal quarantine policies implemented during the epidemic had little effect on overall rates of travel among communities, both when compared to travel rates during non-quarantine periods within the 1918-19 winter and when compared to the same time periods in surrounding years. Observations suggest that although differences in travel rates are not statistically significant, there may well have been a systematic lag in travel of 1-3 days because of the epidemic. This paper pursues the question of whether insignificant differences in travel, such as those observed, can nevertheless lead to significant differences in the timing and overall impact of disease spread, which occurs as a consequence of that travel. In other words, how sensitive are overall epidemic patterns to small differences in the rates and patterns of travel linking communities within a region?

Computer simulations of the spread of the 1918-19 influenza epidemic among the three Cree-Métis communities are used to address this question. Quarantine practices are modeled using inferences from the ethnographic record on how community leaders responded to reports of the epidemic. Simulations implementing different effects on both overall rates of travel as well as relative rates among communities in response to these quarantine practices are compared to assess the impact on epidemic spread of small changes in rates of travel.

Quarantine is a common response of human populations to the threat of human diseases, yet its effectiveness has varied in different locations and at different times. Results from these simulations will aid in understanding how variations in such policies link directly to underlying disease patterns and may aid in the development of more effective practices to control the spread of infectious diseases.

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A preliminary census and study of habitat use of the primates of the northern Iwokrama Reserve, Guyana. M.L. SAUTHER, Anthropology Department, University of Colorado, Boulder CO 80309; B. WRIGHT, Department of Anthropology, University of Illinois, Urbana IL; and K. ORNDORFF, Northwestern University Medical School, Chicago IL.

Little is known about the habitat use of the primates of Guyana. During June-July 1997 we established habitat profiles and censused the primate populations along 5 separate forest transects in the northern portion of the Iwokrama Reserve, Guyana. We also censused one transect of forest adjacent to the reserve on the opposite bank of the Essequibo River. We recorded all separate encounters with the primates visually or by sound. Habitats were described by recording, at 100 m intervals, the attributes of trees 10 cm dbh or larger within 5 m of either side of the census transect. We found 8 species of primates: *Alouatta seniculus*, *Ateles paniscus*, *Cebus olivaceus*, *Cebus apella*, *Saimiri sciureus*, *Pithecia*

pithecia, *Saguinus midas*, and *Chiropotes satanus*. Our results indicate that specific habitat characteristics may influence primate distribution in this area. *A. seniculus*, *A. paniscus*, and *C. olivaceus* were commonly found in sympatry. Group density for these species was greatest in old growth, primary forest characterized by large, uniformly placed trees with high average crown diameter and a high percentage of lianes. *C. apella*, *S. sciureus*, *P. pithecia*, *S. midas*, and *C. satanus* were only encountered in the secondary, disturbed habitat on the opposite bank of the Essequibo river, which they inhabited in sympatry. *A. paniscus* appears sensitive to the maturity of the forest, as they occurred more often in old growth habitats consisting of large, uniformly sized trees. The two *Cebus spp.* were better represented in disturbed habitats such as near farms, or secondary forests, but *C. olivaceus*, which also favors old growth primary forest, had a much wider distribution than *C. apella*. *A. seniculus* occurred at dramatically lower densities in disturbed habitats, but were more common than the other species along river edges. Finally, an inverse relationship was found between the density of *A. seniculus* and *A. paniscus*. Where *A. paniscus* were more common *A. seniculus* occurred at lower densities and vice-versa. These results are discussed in light of broader sociological and conservation issues, and when added to data presented by Sussman and Phillips-Conroy (1994), provide an expanded picture of the distribution of Guyanese primates. This study was supported by grants from the Burt Fund, the Linnean Society, the University of Illinois Graduate College, the Department of Anthropology at the University of Illinois, and Sigma Xi.

Historical, demographic and skeletal studies of a nineteenth century Canadian church cemetery. S. SAUNDERS, L. SAWCHUK, D. HERRING, R. HOPPA, S. KLEPP, Anthropology, McMaster University, Hamilton, Ontario, L8S 4L9.

The St. Thomas' skeletal sample (N=577) is one of the largest historic period samples in North America. A complete set of parish records for the cemetery lists 1564 individuals buried over the 53 years. The skeletal sample represents almost 40% of all interments. Other historical documents are available including censuses, municipal assessment rolls, newspapers, directories, personal letters and accounts. A small proportion of skeletons (N=72) are personally identified from inscribed coffin plates. These resources allow for a comparison of demographic reconstructions from historical documents and skeletons. It is also possible to investigate the rural to urban transition characteristic of many 19th century North American populations and the health implications of such a change.

Life expectancies calculated for the skeletal sample and the parish records, before taking into account reconstructed levels of population growth and migration, show large discrepancies between the two data sources. Adjusted life expectancies yield a closer fit. The original differences are explained not only by demographic forces but also factors of bone preservation and biological techniques of age estimation.

Our analysis of the St. Thomas' skeletal sample shows that the Quality of Life Index developed for the "Health and Nutrition" project is difficult to apply to skeletal samples of differing sizes and composition. While the Index avoids the bias of age effects on skeletal indicators of stress, it is the original structure of skeletal samples themselves which creates problems for researchers.

Our investigation identified the biasing factors that are the most important in attempts to apply the Index to the St. Thomas sample. These are, the small size of the observable skeletal sample and the exclusion of older adults, not from samples, but from data observations because of preservation problems. While the differing effects of population growth and migration on past populations can be estimated and modelled in many circumstances, it is extremely hard to know when various models of mortality are appropriate.

Effects of Schizophrenia on Universal Human Facial Expression

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Schizophrenia is known to interrupt normal facial expression in many of its sufferers. There is also a great deal of evidence for the universality of human facial expressions. In this research, I investigated the hypothesis that schizophrenia is recognizable cross-culturally because it affects species-wide facial expressions in humans. I expected that evaluators, without previous knowledge of the subjects, would be able to distinguish the facial expression typical of patients with schizophrenia from that of non-patient controls.

I collected cross-cultural evaluations of the nonverbal expressivity of patients with schizophrenia and non-patient control subjects from Papua New Guinea and New Zealand. Videotapes of interviews with subjects (without sound) were shown to evaluators, New Zealanders and a Papua New Guinean unaware of the diagnostic status of the subjects. Evaluators provided a 1-7 rating of expressivity and a judgment about whether or not subjects appeared unusual in any way, along with a list of facial expressions and nonverbal behavior that contributed to their judgment.

In both populations, subgroups of consistently less expressive patients could be distinguished. Cross-cultural evaluations confirmed the existence of universally recognizable flattening of expressions in Papua New Guinean patients. Seventy-five percent of low scoring patients also exhibited smooth pursuit eye-tracking dysfunction, a biological marker for schizophrenia. This suggests that the underlying condition of schizophrenia was similar to patients in New Zealand and elsewhere.

Schizophrenia appears to disrupt universal human facial expression. In addition to overall flattening of expressions, there are also problems in particular areas of facial expression and body movement. Eyes and hand movements were among the more commonly reported areas of disrupted expression in patient subjects. Cross-cultural evidence for this pattern of disturbance provides clues to the evolution of normal human interaction and facial expression.

Relationship between prehensile tail anatomy and kinematics in two atelines. D. SCHMITT, Duke University, Durham NC 27710, J.E. TURNQUIST, University of Puerto Rico, Medical Sciences Campus, San Juan, PR 00936, M.D. ROSE, New Jersey Medical

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Ateles and *Lagothrix* both have prehensile tails that are used during locomotion and feeding. These two genera, however, differ in locomotor behavior and tail anatomy. *Lagothrix* spends more time traveling quadrupedally and less time arm-swinging than does *Ateles*. *Ateles* has more numerous caudal elements with wider transverse processes, particularly in the region at the base of the tail, bulkier mm. abductor caudae medialis, and more cranially placed mm. intertransversarii caudae than does *Lagothrix*. The osteological and myological differences suggest to us, and others, that during arm-swinging *Ateles* should show more tail extension (the tail should reach farther forward) and be better able to control lateral body sway.

To test these predictions, *Ateles fusciceps* and *Lagothrix lagothricha* were videotaped while brachiating along a 25' long pole in a large enclosure at the Dumond Conservancy in Miami. Tail-body angle and the degree of lateral body sway were calculated by digitizing simultaneously collected lateral, frontal and overhead images of both species.

The predictions from the anatomical data were fully supported by the kinematic data. *Ateles* consistently hyperextends its tail to a greater degree than does *Lagothrix*, and experiences smaller side-to-side trunk movements during arm-swinging.

These data support the notion that the prehensile tail is a critical element in ateline arm-swinging. It also supports the hypothesis that vertebral features may be used to infer the nature of locomotion in fossil species. Furthermore, these data suggest that tailless Miocene catarrhines with postcranial features similar to atelines must have controlled lateral body sway by mechanisms more like those of the hylobatids.

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Relationships between corpus callosum morphology and behavior in normal human females.

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Sex differences in corpus callosum morphology (when controlling for brain size) have been reported in the literature. Females tend to have a larger relative corpus callosum cross-sectional area, with a more bulbous splenium. This has led to suggestions that these anatomical differences are the result of selection on different behavioral abilities during our evolutionary history (Holloway 1983, 1990). A number of recent studies suggest that corpus callosum morphology is related to behavioral ability on some cognitive tasks.

The present study assessed the strength of corpus callosum / behavioral ability correlations for an expanded the range of behavioral domains, both between- and within-families. 36 pairs of sisters (72 individuals total) where given a diverse battery of cognitive tests (linguistic,

mental rotation spatial ability, frontal-lobe specific, and general reasoning ability), a test of throwing ability, and were asked to provide information about their relative degree of sociality. High resolution MRI brain scans (voxel size: $\sim 1.3 \text{ mm}^3$, with no gaps between slices) were obtained, from which several neuroanatomical features were quantified, including overall brain volume, cortical grey volume, total corpus callosum cross-sectional area, and cross-sectional areas of the genu, body and splenium of the corpus callosum. Within- and between-family correlations were calculated (controlling for age and simple reaction time) among the behavioral and neuroanatomical variables. Between-family correlations were either very small or negative. Within-family correlations were similar, although with somewhat larger *negative* associations (some reaching significance). Of interest is the fact that the highest positive correlations occurred between corpus callosum measures and sociality variables. The possible evolutionary implications of these findings are discussed, as are questions regarding the difficulty of applying within-species associations to evolutionary questions.

Chimpanzee stable isotope data in hair: diet selectivity and habitat use. M.J. SCHOENINGER, University of Wisconsin, Madison WI 53706, J. MOORE, University of California at San Diego, La Jolla, CA, J.M. SEPT, Indiana University, Bloomington, IN 47405, J.CASAMAJOR, University of Wisconsin, Madison WI 53706.

Carbon and nitrogen stable isotope ratios in chimpanzee (*Pan troglodytes*) hair collected from night nests are compared with other primate data (Schoeninger et al. 1996 *AJPA* 109:69-83 & in press *Oecologia*). 1) Ugalla, a savanna/woodland south of Uvinza in western Tanzania, had an average $\delta^{13}\text{C}$ value (-22.0 ‰ , s.d.=0.3, n=12) most similar to Madagascar prosimians from a drought afflicted forest. 3) Data from the Soudano-Guinean woodland of southwestern Mali are similar ($\delta^{13}\text{C}=-22.0 \text{ ‰}$, n=2). 2) Ishasha River (savanna/woodland of eastern Zaire) data ($\delta^{13}\text{C}=-23.1 \text{ ‰}$, s.d.=0.3 ‰ , n=10) approximate New World monkeys and African prosimians from dry, deciduous forests. Ishasha chimps apparently feed only in the forest or forest edge rather than the savanna. 4) Lake Telle region swamp forest of northern Congo samples ($\delta^{13}\text{C}=-25.4 \text{ ‰}$, n=2) approximate New World monkeys from closed-canopy evergreen forests.

$\delta^{15}\text{N}$ values at Ugalla (2.3 ‰ , s.d.=0.6, n=9) indicate dependence on legumes consistent with fecal evidence of Caesalpinaceae seeds. Most Ishasha $\delta^{15}\text{N}$ values (5.9 ‰ , s.d.=0.8 ‰ , n=7) are similar to those in the fruit-eating *Ateles* and frugivorous folivore *Brachyteles* and significantly lower than insectivorous *Cebus* and *Galago*. Two Ishasha samples (10.2 ‰ and 10.4 ‰) have values indicative of meat eating or of starvation.

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Morbidity and mortality in the Late PPNB population from Basta (Jordan). M. SCHULTZ, Zentrum Anatomie, University of Göttingen (Germany), M. BERNER, Abteilung Anthropologie, Museum of Natural History, Vienna (Austria) and T.H. SCHMIDT-SCHULTZ, Zentrum Biochemie, University of Göttingen (Germany).

Nature, cause, spread and frequency of inflammatory and deficiency diseases, as well as physical strain in the Late PPNB population from Basta were studied to enlarge our knowledge of the morbidity and the mortality of early Neolithic populations. Furthermore, an attempt was made to reconstruct the living conditions such as nutrition, housing and working conditions, geographic and climatic facts, and sanitary and hygienic factors of this population.

For this study, 39 more or less well represented skeletons were examined by macroscopic, endoscopic, radiological, light and scanning-electron microscopic techniques.

In 2 out of 29 individuals, cut marks could be observed in the skull. This could be interpreted as ritual or special mortuary practices. There is strong evidence of skull trauma. Out of 29 individuals, 5 show healed fractures of the skull vault. Osteoarthritis is present, but relatively mild. The intensity of osteoarthritic changes increases with individual age. There are no significant differences between males and females in the frequency of diseases. Stress markers, such as Cribra orbitalia (n = 5/22), transverse linear enamel hypoplasia (n = 19/24), Harris lines (n = 7/7) and periosteal reactions (n = 11/24) demonstrate that life was relatively hard.

There is only little evidence of malnutrition. Possible anemia was found in 9 out of 30 cases, scurvy in 2 out of 24 cases. Alterations due to inflammations are relatively frequent, but, as a rule, fewer than in Bronze Age populations: meningitis (n = 14/30), mastoiditis (n = 2/22), sinusitis frontalis (n = 8/13) and sinusitis maxillaris (n = 14/20). The frequency of the diseases of the teeth and the jaws indicates poor hygiene: stomatitis (n = 5/20), dental calculus (n = 19/24), parodontopathy (18/24), dental abscesses (n = 6/23) and intra vitam tooth loss (n = 7/23). Dental caries was extraordinarily rare (n = 2/22).

Morphological Affinities of European Upper Paleolithic and Modern Holocene Populations. B.A. SCHUMANN, Department of Anthropology, Florida Atlantic University, Boca Raton, FL 33431.

The European Upper Paleolithic, from 45,000 to 10,000 BP, marks the first appearance of anatomically modern humans in Europe. While this population has played an integral role in the debate over modern human origins, its use in determining the relationship between Pleistocene modern humans and more recent, Holocene

populations has been limited. Using cranial data from 21 modern populations (n=1857, Howells 1973) and factor and discriminant analyses, this study identifies the recent population affinities of 21 Upper Paleolithic fossil hominids.

A factor analysis using the principal component method of extraction differentiated all populations based on major cranial breadths (asterionic, auricular, maximum and maximum frontal bone; PC1=43%) and facial breadths (fronto-malar, nasal and orbital; PC2=14%). Compared to Howells' 21 modern populations, the Upper Paleolithic is most similar to Siberian Buriats with respect to PC1 and most similar to Australians and Tasmanians on PC2. A canonical discriminant function classification analysis correctly classified 64.9% of all specimens. All of the recent populations were classified between 41.8% (Japanese) and 81.1% (Bushman), with the exception of Buriats, 90.8% of which were classified correctly. 90.5% (n=19) of the Upper Paleolithic sample was classified correctly. Of the two specimens incorrectly classified, one was classified as a Zavalav and the other as a Bushman.

These two analyses indicate that while modern (Holocene) populations of differing geographical regions vary according to cranial size and shape, especially in the upper face, the Upper Paleolithic sample forms a more cohesive and well delineated population. The similarities between Buriats and the fossil sample in the factor analysis are accounted for by extremely broad cranial vaults, especially in the basal and parietal regions. Nevertheless, the overall morphological pattern (vault and face) of Upper Paleolithic hominids is unique and thus precludes any direct association (through classification) with any specific, recent population or region.

Genetic associations across the Bering Strait: continuities and discontinuities. T.G. SCHURR, J.T. LELL, Emory, R.I. SUKERNIK, E.B. STARIKOVSKAYA, Institute of Cytology and Genetics, Novosibirsk, D.C. WALLACE, Emory.

To investigate the origins and affinities of native Siberian and Native American populations, we characterized the mitochondrial DNA (mtDNA) and Y-chromosome variation in these groups. The analyses of mtDNA variation generated both high resolution RFLP haplotypes and control region sequences from these groups. These data showed that Siberian groups exhibited only three of the four primary haplogroups (A, C and D) observed in Native Americans, while also having several mtDNA lineages not present in the New World. They also revealed that the Chukchi, Siberian Eskimos, and other circumpolar populations (Alaskan Eskimos and Aleuts, Na-Dene Indians) were closely related, and had expanded relatively recently in the Beringian region from common ancestral populations. In contrast, the Koryaks and Itel'men were distinguishable from Chukotkan populations, and to some degree from each other. Both Kamchatkan groups also showed genetic links to the Nivkhs, Udegeys, Koreans and Japanese, implying their recent expansion into northeastern Siberia from the Sea of Okhotsk and Amur River regions.

For the analysis of Y-chromosome variation, we generated compound haplotypes from the combinations of alleles present at four bi-allelic loci (DYS199, DYS7C, RPS4Y, DYS287), one tetranucleotide locus (DYS19), and three

trinucleotide loci (DYS388, DYS390, DYS391). The distribution of these Y-chromosome compound haplotypes in Siberians and Native Americans implied that at least two population expansions produced the present day Y-chromosome variation in New World populations. It also revealed greater haplotypic diversity in native Siberian populations relative to Native Americans, and considerable regional differentiation of northern Asian groups.

Overall, the mtDNA and Y-chromosome data indicate that ancestral Siberian and New World populations arose from common genetic stocks which spread from East-Central Asia into each continental area prior to the last glacial maximum. They further show that, since this time, native Siberians have experienced multiple genetic influences from other ethnic groups due to population expansions within northern Asia, whereas Native American populations have been isolated from these events.

Philosophical and methodological naturalism and the teaching of evolution: The problems of purpose, design, and cause. E.C. SCOTT, National Center for Science Education, Inc., 925 Kearney St., El Cerrito, CA 94530-2810.

At universities, an increasing number of students reject or express discomfort about evolution, including not only 6-day creation, Biblical literalists, but also Catholics and mainline Protestants. Because evolution, like all scientific theories, is restricted to explaining through natural cause (methodological naturalism), many students confuse the *ability* to explain through natural cause with a conclusion that therefore God does not exist (philosophical naturalism.) To some, this means life thus has no purpose or meaning, and acceptance of evolution brings on an existential crisis. But this confuses methodological and philosophical naturalism, which are separate.

When G.G. Simpson says, "Man is the result of a purposeless and natural process that did not have him in mind" (*The Meaning of Evolution*, 1967, p. 344), most scientists think, "no orthogenesis". Religious students hear, "God doesn't count". When scientists say, "there is no design", they usually mean, "no teleology". Religious students hear, "God doesn't count". When scientists say, "natural selection causes evolutionary change" they cannot as scientists be speaking of ultimate cause, rather they refer to proximate or intermediate cause, but religious students often hear, "God doesn't count". Many religious students want to retain God as ultimate Creator, but are willing to let science explain the proximate details of how things came to be. To allow students to accommodate their religious views to science, professors must be careful of how they treat concepts like *purpose*, *design*, and *cause*, which have different meanings beyond their scientific ones, and not to confuse methodological with philosophical naturalism.

Mitochondrial DNA diversity and biogeography of Eastern gorillas. M. I. SEAMAN, Department of Anthropology; K. SALTONSTALL, Department of Ecology and Evolution; and K. K. KIDD, Department of Genetics, Yale University, New Haven, CT 06520.

The two Eastern subspecies of gorillas, the mountain gorilla (*Gorilla gorilla beringei*) and the eastern lowland gorilla (*G. g. graueri*), exist today in several isolated populations with little or no contact with other populations due to human presence. In order to understand the evolutionary history of the Eastern gorillas, we examined the amount and pattern of mitochondrial DNA sequence variation in two populations of mountain gorilla (Virunga mountains, Rwanda-Uganda-Congo/former Zaire; Bwindi Impenetrable National Park, Uganda) and three populations of eastern lowland gorilla (lowland and montane populations of the Kahuzi-Biega National Park, Congo/former Zaire; Mt. Tshiaberimu, Congo/former Zaire), to determine if any of these populations has been genetically isolated for a long period of time; or conversely, if any populations which are now separated may have been inter-breeding in the recent past.

We amplified and sequenced the first hypervariable segment of the mitochondrial control region ("D-loop") from seventy-two individuals using naturally-shed hairs collected non-invasively from gorilla nests in the above-mentioned populations.

The results indicate that mitochondrial haplotypes are shared across all of the populations examined within both the mountain and eastern lowland subspecies, but that no haplotypes were shared between these subspecies. Furthermore, each subspecies forms a distinct monophyletic clade.

The Mt. Tshiaberimu population of *G. g. graueri* has previously been the subject of some subspecific taxonomic debate. This population, although today separated by nearly 100km from the nearest neighboring population of *G. g. graueri*, shares the most common haplotype seen in the Kahuzi-Biega montane population, suggesting that these populations—and all populations located geographically between them—may have been part of one continuous population in the recent past.

Secular Change of Japanese Occlusion : The frequency of the overbite and its association with food preparation techniques and eating habits. Noriko Seguchi, The University of Michigan, Ann Arbor, MI.

The question of occlusion is one of the essential problems of dental anthropology. Human occlusion has changed dramatically in very recent evolutionary times. Until only a relatively short time ago, the form of "normal" human occlusion was an edge-to-edge bite. That is, when the molars were clenched together, the cutting edges of the upper and lower incisors met each other rather than overlapping. However, modern populations have increasingly developed an overbite, that is vertical overlap of the upper incisors over the lower. The change took place in Europe following the adoption of the dinner fork.

accompanied by the changes in eating habits indicated by this adoption, in the 18th century. A similar change should have occurred in Asia following the change in food preparation methods that facilitated widespread, daily use of chopsticks in China and Japan. Brace's preliminary work in China indicates that the modern overbite is first found in members of China's upper classes in the Song Dynasty (A.D. 960-1279).

In this study, a total sample of 600+ specimens from Japanese pre-historic and historic populations are measured for both overbite and overjet depth. A slight overbite becomes pronounced around the end of the 7th century. Then, the frequency of an overbite sharply increases after the 14th century. According to archeological record and written documents, chopsticks were first imported from China and used by upper class Japanese at the end of the 6th century, and subsequently, their use gradually spread throughout Japan. Also, food preparation technology had changed around the 9-10th centuries. Japanese cooking techniques and eating patterns that were established around the 14th to the 16th centuries have continued until the present. Various cooking technologies, food preparation techniques, and eating behaviors were invented and introduced during the Edo period (A.D. 1603-1867), at it is at this time that the "modern" overbite first appears. Furthermore, the modern Japanese population (after the 20th century) show an increased incidence of a deep overbite and an openbite.

These results indicate that the appearance of an overbite is associated with the adoption of chopsticks, and the development of the overbite is correlates with the history of food preparation techniques and eating habits.

Since humans use their teeth in daily life, these results may have anthropological implications for understanding the impact of cultural factors on ongoing evolution.

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Stereolithographic reconstruction of fossil hominid skulls. H. SEIDLER, G. WEBER, W. RECHEIS, D. zur NEDDEN. Institute of Human Biology, University of Vienna; Dept. of Radiology II, Innsbruck University Hospital, Austria.

CT-scans of some middle pleistocene skulls, from the Neandertal of Monte Circeo as well as from *Australopithecus* specimen has been used to construct stereolithographic models. The technique is based on laser-controlled curing of a liquid photopolymeric acrylate and validated on the skull of the South-Tyrolean Iceman. Stereolithographic modelling reproduces most features within the substance of bones as air-cells or the extent of the paranasal sinus system. The material which we are using is a transparent resin, so all the internal features ("hidden structures") can be observed easily. Even though the enormous extent of pneumatization in *Petalona* is described in the literature, the stereolithographic model reveals unexpected sinuses as an unique morphological feature in this specimen: the greater wings of the sphenoid were "blown up" with an anterior and a posterior wall bordered superiorly by a thin lamella located in the regio of the postorbital constriction, separated by an unusual part of the frontal sinuses ("postorbital sinus"). The models of *Petalona* and Broken Hill - contrary to *Atapuerca 5* - display a similar construction of the anterior and posterior cranial fossae with evidence of a significant different development of the frontal lobes and the neocerebellar hemispheres in respect to *Arago21*,

Neandertals (as Monte Círcico) and modern humans. What we can learn is that external skull morphology does not necessarily correlate with endocranial features. Even though Petralona, Broken Hill and Arago21 are similar in some morphological details, the stereolithographically reconstructed exhibit different endocranial details. Also the Atapuerca 5 specimen resembling Petralona in external morphology and cranial capacity (Arsuaga, 1993; Stringer, 1993) displays a quite different endocranial morphology from Petralona and Broken Hill. So stereolithographic modelling could be used as a new and successful instrument to explore new aspects of cranial morphology for a better understanding of the origin of modern people.

Advances in the study of hominoid brain evolution: Magnetic Resonance Imaging (MRI) and 3D reconstruction. K. SEMENDEFERI, Department of Anthropology, University of California at San Diego, La Jolla, CA 92093-0532.

Recent advances in non-invasive neuroimaging techniques used for the analysis of brain structures in humans are also available for the study of the comparative neuroanatomy of all extant hominoids. MRI and 3D reconstruction of brains *in vivo* as well as of postmortem brain specimens allow for the identification and quantification of many neural structures across species. Use of living subjects facilitates the study of larger samples and also permits the study of species chronically underrepresented (e.g. bonobos, gorillas, orangutans). These new techniques also allow a more accurate descriptive analysis of sulci and gyri as well as quantification of volumes and surfaces devoid of the problems related to the manipulation of postmortem tissue (e.g. shrinkage).

An example of the application of these techniques can be seen in the comparison of the volumes of the frontal lobes across hominoids. We found that, contrary to the traditionally held idea, human frontal lobes are not larger than expected for an ape brain of the human size. On the other hand, preliminary results suggest that the temporal lobes in humans might be larger than expected for an ape brain of the human size, while the human cerebellum is relatively smaller than that of the apes. Intraspecific variation in the size of the hominoid lobes and their sectors is present and can be related to species-specific adaptations in behavior.

Differences or similarities in the size of the lobes and in aspects of the organization of the brain of the extant hominoids allow for hypotheses generation regarding the timing of the change of the structures in recent evolutionary history. Furthermore such information can be combined with paleoneurological data and contribute substantially to our understanding of the evolution of the human brain and cognition.

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Architectural correlates of locomotion in the hindlimb muscles of two guenon species. N. SHAHNOOR and F. ANAPOL, University of Wisconsin-Milwaukee, Milwaukee, WI 53201.

In this analysis of hindlimb myology, differences in muscle architecture are compared between two closely related cercopithecine monkeys that differ in their naturalistic locomotor behavior: the semiterrestrial vervet (*Cercopithecus aethiops*) and the more strictly arboreal red-tail monkey (*C. ascanius*). Spatial arrangement of fibers and tendons is examined in the retractor-abductors of the thigh (gluteal group) and flexors of the leg (hamstring group). Muscle weights, lengths of fasciculi and tendons, and angles of pinnation were measured to calculate physiologically related morphological determinants of strength, speed, and relative isometric or isotonic use of individual muscles.

Interspecific differences are more pronounced in most of the gluteal muscles (caudal gluteus superficialis, g. medius, and g. minimus) than in anterior g. superficialis and the hamstrings (biceps femoris, semimembranosus and semitendinosus). Reduced physiological cross sectional area of g. medius is relatively larger than g. minimus in vervets, while the reverse is true for red-tails. Since force is recruited from deep to superficial, these results indicate a broader range of intensity of muscle use corresponding to 1) greater speeds attained on the ground, and 2) regular movement between arboreal and terrestrial milieus by the semiterrestrial vervet. Greater values for mass/predicted effective tetanic tension and maximum excursion in vervets indicate muscles constructed for speed, rather than force. For red-tail monkeys, higher values for tendon length/fasciculus + tendon lengths favor more isometric use of muscles in the pliant arboreal substrate. This contrasts to a more isotonic use of muscles in vervets for ground quadrupedalism. No statistically significant interspecific differences occur in the hamstring group, although vervets appear to have biological differences favoring speed, rather than strength.

These results support those previously reported for quadriceps femoris and triceps surae in the same specimens, further demonstrating close correlation between muscle morphology and locomotor preferences (Anapol and Barry, 1996). However, interspecific similarities imply that the inherent flexibility of muscle tissue may be preadaptive, thereby enabling a species' response to selective pressure while adapting to a new ecologic niche.

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Size, speed, and spinal kinematics in *Loris* and *Nycticebus*. L.J. SHAPIRO, University of Texas, Austin, TX 78712 and B. DEMES, SUNY at Stony Brook, NY 11794.

The functional morphology and evolution of the vertebral column cannot be fully understood without a consideration of how it is used during actual locomotion. Our previous research on prosimian spinal kinematics documented that in

accordance with their distinct lumbar vertebral morphology, lorises utilize more exaggerated lateral spinal movements than do more generalized cheirogaleids. In this study, we test for the effects of body size and speed on spinal kinematics among three lorises, *Nycticebus coucang*, *Nycticebus pygmaeus*, and *Loris tardigradus*. The study was conducted at the Duke University Primate Center. The sample includes one individual of each species, and a range of 10-22 step cycles for each.

During slow walking, spinal movements of the small-bodied *Nycticebus pygmaeus* closely resemble those of the larger *Nycticebus coucang*, and both species differ from the small-bodied *Loris*. Consequently, there appears to be a true distinction in spinal kinematics between *Nycticebus* and *Loris* that is not size related: lateral movement is more pronounced in *Nycticebus* during walking, particularly at ipsilateral foot touchdown. This difference may be related to body shape variation among the taxa, and the results also suggest the possibility of vertebral morphological variation within lorises.

When *Nycticebus pygmaeus* moves at faster speeds, its lateral spinal movements become less pronounced. The inverse correlation between lateral displacements of the trunk and locomotor speed is consistent with what has been suggested to be a basic amniote adaptation, characteristic of mammals and lizards, but not amphibians.

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New approaches to modeling human population structure with *Alu* elements. S.T. SHERRY¹, H. HARPENDING², M. STONEKING³, M.A. BATZER¹.

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Computer simulations of the *Alu* insertion mutation process in structured populations were conducted to explore the effects of different migration models on principal coordinate genetic maps of *Alu* frequency data. These simulated results were compared to contemporary *Alu* gene frequency data to assess the general sensitivity of genetic maps to various assumptions about migration and non-stationary demographic history.

Simulation software was developed with Delphi 2.0. The genetic maps plotted by the program are based on simulated *Alu* element frequencies for four loci. These frequency distributions, in turn, are derived from random

simulated genealogies that span 16 populations. These genealogies are constructed with a modified version of the coalescent algorithm developed by Hudson in which element frequencies are computed by tabulating the number of mutation-positive terminal nodes in each group.

The simplest genealogies we evaluated had a constant population size through time and equal rates of migration between different pairs of groups. Migration effects were simulated under both island model and stepping stone model assumptions. Each model was evaluated for both moderately low and high levels of gene flow between groups. A second set of simulations examined more complex genealogies by studying the effects of population expansion on both structured and unstructured populations.

Our preliminary exercises suggest that information about ancient human population structure may be recovered from *Alu* element frequency data. This preliminary analysis of different migration models has revealed a consistency between an island exchange model for a stationary structured population and published empirical *Alu* frequency data.

Growth and health of tri-hybrid (Caboclo) populations of the Brazilian Amazon.

H.P. SILVA (Department of Anthropology, The Ohio State University, Columbus, OH 43210, USA).

The majority of inhabitants of the Brazilian Amazon are descendants of a tri-hybrid admixture of Portuguese, African and South Amerindians. In rural areas they are called Caboclos and little is known about either their growth or health patterns. This paper presents data on five groups of Caboclo children (ages 2 - 13 years) inhabiting different environments (peri-urban, flood plain, black water and *Terra Firme*) in the State of Para. Data was collected twice, once in the rainy and again in the dry season. These Caboclo children are short and light for age, they average between the 25th and the 50th percentile of WHO international standards. However, they present BMIs appropriate for their age. Compared to Brazilian groups they are similar to other rural samples. The most frequent diseases observed are cavities (> 65%), anemia (> 80%), and skin infections (> 78%). During the rainy season the incidence of acute respiratory infections reaches 90% in some communities. This is also the period when food is scarce in the flood plain and many families migrate temporarily to other areas. Intestinal parasites affect more than 50% of the general population and contribute to cases of anemia and diarrhea. Of the groups studied four are experiencing intense Westernization, their environment and life styles are changing drastically due to changes in the Brazilian economy. These groups are undergoing biological and environmental stresses that likely are worsening their nutritional

and health status. There is a need to further determine the degree to which such environmental changes affect the growth and health of Caboclo children.

Functional variation in the vertebral morphology of prosimians. C.V.M. SIMONS and L.J. SHAPIRO, Dept. of Anthropology, University of Texas, Austin, TX 78712.

The behavioral and morphological diversity exhibited by prosimians makes them an excellent sample with which to sort out the influences of function, phylogeny, and body size on form. Prosimians vary widely in their habitual postures and the types of spinal movements that they utilize during locomotion, yet few studies have addressed their vertebral morphological variation quantitatively. As part of a broader study examining many aspects of prosimian vertebral morphology, this analysis addresses variation in vertebral body shape and overall length of the lumbar region among 20 species of prosimians including lorises, galagids, lemurids, cheirogaleids, indrids, and lepilemurids.

Based on biomechanical principles and previous research on prosimian postcranial anatomy, it was hypothesized that the vertebral morphology of prosimian leapers would differ depending on the posture from which they regularly leap. As predicted, the vertebral bodies and lumbar regions of both small-bodied and large-bodied vertical clingers and leapers appear to be relatively short compared to those of prosimians that rely on quadrupedalism or leaping from a horizontal position. One interesting exception to this pattern is *Lepilemur*, which has a notably elongated lumbar region in comparison to those of other vertical clingers and leapers.

Among the lorises, a group characterized by very specialized locomotion, the two larger taxa, *Nycticebus* and *Perodicticus*, have relatively short lumbar regions compared to the smaller *Loris* and *Arctocebus*. Overall, lorisid lumbar vertebral bodies are relatively short compared to those of other quadrupedal prosimians. *Arctocebus* is an exception, with remarkably elongated vertebral bodies compared to those of other lorises. The distinctiveness of *Arctocebus* in this regard may be part of a functional complex including broadened ribs and notable reduction of vertebral muscular lever arms.

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The phylogenetic affinities of *Otaviipithecus namibiensis*: a parsimony analysis of hominoid mandibular morphology. M. SINGLETON, Department of Anthropology, Washington University, St. Louis, MO 63130, USA

Otaviipithecus namibiensis is known from a single mandibular specimen and presents a unique mosaic of dental

and gnathic characters. The singular morphology and limited nature of this specimen have given rise to competing hypotheses concerning its phylogenetic affinities (Andrews 1992, Conroy 1994, Begun 1994). To clarify these relationships, a comprehensive phylogenetic analysis of morphological characters of the hominoid mandible and dentition was conducted.

The study sample comprised 598 mandibular specimens representing 39 extant and fossil hominoid species. Qualitative characters were scored for each individual by visual assessment. Quantitative characters were represented by a.) log-transformed ratios of linear variables and b.) residual values from the ordinary least squares regression of log-transformed linear variables, and character values were converted to discrete character states by gap-coding (Mickevich and Johnson 1976). The resulting quantitative character state distributions were combined with the qualitative character matrix, and parsimony analyses were performed using the PAUP phylogeny reconstruction program.

Parsimony analyses of all mandibular character matrices yield similar results. Minimal trees show topologies congruent with established extant hominoid relationships, high consistency indices (≈ 0.80), low retention indices (≈ 0.50), and high homoplasy indices (≈ 0.75). *Otaviipithecus* forms a clade with *Afropithecus* and the large-bodied hominoid specimens from Napak, Uganda. *Kenyapithecus* and *Griphopithecus* are variably associated with this group. Relations within this clade and between it, the great ape clade, and other large-bodied hominoids are largely unresolved. Under bootstrap analysis only the *Afropithecus*-Napak pairing achieves a 50% confidence level.

The results of phylogenetic analyses based on a single, functionally-integrated morphological region such as the mandible must be treated with caution. With this caveat, these results support Andrews (1992) grouping of *Otaviipithecus*, *Afropithecus*, and *Kenyapithecus*, but are neutral with regard to the position of this group relative to the African ape clade or its appropriate taxonomic status. Further explication of the phylogenetic affinities of *Otaviipithecus* must await recovery of additional material, but these results confirm that *Otaviipithecus*, though geographically remote, is firmly anchored in the African Middle Miocene hominoid radiation.

Intelligent tool use in wild Sumatran orangutans (*Pongo pygmaeus abelii*). A.F. SITOMPUL,* E.A. FOX,** & C.P. VAN SCHAIK,** *Leuser Development Programme, Medan, Sumatera Utara, Indonesia; **Biological Anthropology and Anatomy, Duke University, Durham, NC 27708

The recent discovery of tool manufacture and flexible tool use by wild Sumatran orangutans prove that wild orangutans both possess and express the cognitive capacities necessary to manufacture and use tools (van Schaik & Fox, 1994). The current study presents evidence for an orangutan tool kit, with further implications for orangutan intelligence.

Wild orangutans have been studied at the Suaq Balimbing Research Station, Sumatra, Indonesia since February 1994. Over 10,000 hours of observational data were collected from a study population of 51 habituated individuals. All age-sex classes, including infants, were observed to make and use tools. Tools were used in two feeding contexts: (1) extractive foraging for insects and (2)

extracting seeds from hard-husked *Neesia* fruit. Tool-using orangutans have also recently been discovered at the Trumon site, approximately 40 km from Suaq Balimbing, but to date only seed-extractive tool use has been observed.

Tools used for insect- and seed-extraction differed significantly in both length and width, and it was almost always possible to accurately differentiate seed- and insect-extraction tools by eye. Seed-extraction tools collected from the two study sites do not differ in length or width. These data demonstrate that orangutans have a *tool kit*.

Seed-extraction tool width increased as the 3-month *Neesia* seasoned progressed. This change corresponds to the widening of the point of tool insertion in the *Neesia* fruit.

These observations indicate that wild orangutans are able to: (1) understand the physical properties needed in a tool; (2) modify a raw material so that it meets these requirements, and (3) relate each tool to a particular task and manufacture the tool to meet the corresponding demand.

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Attachment and paternal investment in divorced fathers.
L.B. Slater, University of Washington, Seattle, WA 98195.

Paternal investment has been widely hypothesized to be an important aspect of human evolution, underlying the development of human family formation. Little is known about the proximate psychological mechanisms that influence investment; attachment has been suggested as one possible such mechanism. The form paternal investment takes is sensitive to social context, particularly with regard to divorce, which is often followed by declining investment. This project investigated father-to-child attachment and the relationship of attachment to paternal investment by interviewing 60 divorced fathers in King County, WA.

Of the 60 fathers, 54 were identified from a random sample of court records and 6 others were included to increase the number of non-investors in the sample. Children in the court sample were age 11 or under. The interview was composed of a section each on family history, father's relationship with his oldest child, and custody and support. Interviews were audiotaped and transcribed.

Attachment was defined in terms of desire for proximity, provision of a secure base, and separation protest/distress. All of these fathers could be considered attached to some degree to their child. More investors than non-investors were concerned over providing a secure base for their child, although all expressed desire for proximity. That fathers as well as children receive benefits from paternal investment was clear: all fathers stated that being a father was rewarding, and almost all felt that their children also took care of them, most often by providing for their emotional needs. Almost all fathers stated that they were influenced in parenting by childhood memories of their own parents.

Almost a quarter of the sample were not investing either

time or money in their child. Non-investment of time was related to conflict with the ex-wife, and non-investment of money to low income. Several current investors described non-investment with other offspring; clearly whether a man invests paternally can vary over his life between children and with the same child at different times.

Results support the hypothesis that attachment is positively related to paternal investment, and that in the context of divorce investment is sensitive to a father's economic resources and relationship with the child's mother. Supported by a NSF dissertation improvement grant.

A systematic approach to characterizing primates: a three-way ratio of cranial sinus area. S.T. SLEMMER, University of Tennessee, Knoxville, TN 37996.

Mammalian paranasal sinuses have been studied in terms of the physiological function they serve as well as the phylogenetic information they provide. An examination of the primate cranium reveals that much of the cranial space can be packaged into three primary areas: the frontal sinus, the nasal cavity and the cranial fossa. This is true for all primates, however, an understanding of primate morphology and behavior demonstrates that cranial capacity, olfactory abilities and frontal sinus expression vary among taxa.

Tracings were made of the frontal sinus, nasal cavity and cranial fossa from standard radiographs of specimens of *Saimiri*, *Theropithecus*, *Macaca*, *Hylobates*, *Gorilla* and modern humans. Sinus area was calculated from those images, and a three-way ratio of areas was recorded for each specimen. A triangular plot of these ratios revealed variation among taxa both in total sinus area and in sinus pattern. While modern human sinus area is clearly dominated by the cranial fossa, the frontal sinus is a significant component of total sinus area in *Gorilla*. Much of the total sinus area for both cercopithecines is contributed by the nasal cavity.

This preliminary analysis of primate cranial sinuses demonstrates that sinus pattern and sinus area have an association of both function and phylogeny. This method would be useful in categorizing other primates and should be considered in analyses of primate morphology.

Morpheus et al.: cross-platform software for morphometric research. D.E. SLICE, Ecology and Evolution, SUNY at Stony Brook, 11794-5245.

Morpheus et al. (Morpheus) is a software package providing an extensive array of functions for the collection, processing, and analysis of a wide variety of data relevant to the study of shape in physical anthropology. Supported data types include user-

supplied variables, point coordinates, curves, images, and dynamically calculated distances, angles, etc. Analytical, processing, and visualization methods include familiar univariate and multivariate tools, such as regression and principal component analyses, as well as methods tailored specifically to the analysis of morphometric data, such as methods for the superimposition of homologous landmarks, the visualization of differences and variation using thin-plate splines, and the analysis of object outlines or curves. Command-line and graphical versions of the program are available for a variety of computational platforms with the command-line versions providing all the computational functionality of the graphical version. Supported platforms include UNIX/X systems, DOS/MS-Windows, and the Macintosh. The utility and flexibility of Morpheus for anthropological research are demonstrated using data from scapulae of lowland and mountain gorilla (Taylor, 1997).

Morpheus is freely available by anonymous FTP from life.bio.sunysb.edu/morphmet/morpheus or from the WWW at <http://life.bio.sunysb.edu/morph/morpheus>. The development of Morpheus has been supported by a grant (BIR-9503024) from the National Science Foundation.

A Possible Historic Case of Gender Role Reversal. Diana SMAY and Alison GALLOWAY, Anthropology at University of California, Santa Cruz, CA 95064 and Richard T. MASON, Office of the Sheriff-Coroner, Santa Cruz, CA 95060.

In August 1996, the skeletonized remains of an adult individual were recovered in a mountainous region of Santa Cruz County. Artifacts associated with the remains include a gold watch and watch chain, a whiskey bottle, a revolver and assorted coins. The most recent of the coins dates to the 1890s. The context suggests that the bones had remained undiscovered on the surface for approximately 100 years.

Despite cultural items that support a determination of male, the biological profile determined from the skeleton is typical of a female. This is indicated by the wide sciatic notch, relatively vertical forehead, extremely small mastoids and gracility of the nuchal region and postcranial skeleton and general lack of pronounced muscular attachments. Cranial and postcranial metric analysis also supports a determination of female. Age assessment based on the auricular surface indicates an age of 30-40 years at the time of death. Determination of ancestry based on both metric and non-metric analyses suggests that this person is primarily of European descent. Stature is calculated at approximately 163-171 cm. No perimortem trauma is evident, leaving the cause of death undetermined at this stage of the research. Postmortem erosional damage has resulted in loss of the anterior ribs, sternal body and pubic region while rodent scavenging defects are visible on the cranium and some long bones.

Antemortem damage to the remains consists of a well-healed midshaft oblique fracture of the right femur. In addition, there is a healed nasal fracture. There is some antemortem loss of dentition, although the remaining teeth are in relatively good condition. Evidence of periodontal

disease affecting the anterior mandible is present. No arthritic changes are evident.

A review of the historical records does not provide an identity for this individual. Around the turn of the century, the Santa Cruz Mountains supported a wide range of enterprises focusing on a mixture of lumbering and farming, as well as other less legitimate concerns. The questions remain: Did we mistakenly assume that these cultural items were "male"? Are the skeletal indicators of sex simply beyond the expected range for males in this individual? Or, did this individual cross between gender roles, finding in the Santa Cruz Mountains a place to live and die without adhering to cultural norms?

The diet of extant hominoids as reflected in 2-D molar occlusal morphology. E.J. SMITH, University of Toronto, Toronto, ON, M5S 3G3, Canada.

Extant primates of known dietary specializations are often used as models in order to study the functional morphology of fossil dentitions. This paper will present the results of the first part of this type of study - a model of extant hominoid molar morphology.

Data were collected from 174 gorillas (including all 3 subspecies), 106 bonobos, 86 chimpanzees, 73 orangutans (including both subspecies), 85 gibbons and 25 siamangs. Occlusal surfaces of upper and lower molar were video-taped and digitized and a maximum of 195 measurements per individual were recorded. Measurements include: crown area, perimeter and major and minor axis lengths; areas of cusps, accessory cusps and cingula; and distances and angles between cusp tips. Statistical tests (descriptive statistics, ANOVAs and PCA) were performed to determine how molar morphologies compare among hominoids with similar diets, and among hominoids that are closely related but display different diets.

The results show that folivorous taxa (eg. gorillas and siamangs) display a number of trends that differ from more frugivorous taxa. For example, the cusps at the distal end the cristid oblique and crista obliqua (hypoconid and metacone respectively) are consistently larger among folivores, the hypoconulid areas of all molars are larger among folivores, and many cusp areas tend to be more variable among frugivores.

The ultimate goal of this project is to use this model to analyze the functional morphology and intraspecies variation in Miocene hominoid dentitions.

This project was supported by grants from NSERC, the province of Ontario, the University of Toronto and the AMNH.

Shape variation of the human pollical distal phalanx. S.L. SMITH, University of Texas at Arlington, Arlington, Texas, 76019.

Human distal pollical phalanx form has been presumed to be associated with tool manufacture, and the broad tuft

of these Neanderthal bones has been suggested to be a climatic adaptation and/or an aid to a tremendously powerful grip. To augment knowledge of distal pollical phalanx shape, variation is explored among samples of modern humans and compared to that of some pre-modern fossil hominids.

Modern samples include Terry "black" and "white" males (M) and females (F) (40 each); Larsen Bay, Alaska (6 M, 14 F); Chinese, Alaska (11 M); Lisht, Upper Egypt (5 M, 2 F); and Sully and Mobridge, S. Dakota (10 M, 4 F; 7 M, 5 F). Fossils include the robust australopithecine SKX 5016 (SK) and Neanderthals from Kiik-Koba (KK; N=1), Shanidar (SH; N=4), and Krapina (KR; N= 4).

Length-width ratios were calculated from maximum and interarticular lengths and radioulnar (ru) and dorsopalmar (dp) widths of the base, mid-shaft, and tuft. Larsen Bay males are the most robust moderns for base, ru mid-shaft, and dp tuft, Larsen Bay females for dp mid-shaft, and Terry white males for ru tuft ratios. Egyptian females are most gracile for base and ru mid-shaft and tuft, Chinese males for dp tuft, and Terry black females for dp mid-shaft ratios.

When the combined-sex Larsen Bay sample is used as a reference population against which to create pattern profiles (from z-scores of 6 interarticular length to width ratios) for SK, KK, and mean values for SH and KR, the fossils show a similar pattern, with $dp > ru$ for respective ratios (base, mid-shaft, and tuft) relative to Larsen Bay. The most salient difference is for the ru tuft ratio, with z-scores of -2.6 for SH and KR, -3.3 for SK, and -3.7 for KK. It is unlikely this shape difference is a simple correlate of climate, due to the distinction of the fossils from the Larsen Bay sample and the gracility of the Chinese Alaskan males. A general correlate of overall body proportions remains a possibility, as does a grip strength relationship.

Data collection was supported by a Smithsonian (NMNH) postdoctoral fellowship.

Size of the adult human vomeronasal organ. T.D. SMITH, A.M. BURROWS, School of Physical Therapy, Slippery Rock University, Slippery Rock, PA, 16057, M.I. SIEGEL, M.P. MOONEY, Department of Anthropology, University of Pittsburgh, Pittsburgh, PA, 15260, P.A. FABRIZIO, and F.R. CLEMENTE, Department of Physical Therapy, Duquesne University, Pittsburgh, PA, 15282.

In previous investigations, the human vomeronasal organ (VNO) has been shown to increase in volume across three trimesters of fetal development. However, it is unclear to what extent these epithelial structures may increase in size postnatally.

Nasal septa from five adult human cadavers (65 to 86 years of age) were histologically sectioned at 25 μ m, stained (hematoxylin and eosin), and mounted on glass slides. Specimens were examined for presence of the VNO by light microscopy (to X640). Bilateral VNOs were found in four specimens and a unilateral VNO was seen in one specimen. VNOs were quantified using a three-dimensional computer reconstruction technique.

Seven right or left VNOs were suitable for quantification (i.e., without epithelial damage). The adult VNOs ranged from 4.2 to 7.4 mm in length (mean = 5.96mm) and from 3.9 to 19.7×10^{-4} cc in volume (mean = 11.2×10^{-4} cc). The vomeronasal epithelial volume (overall VNO volume - VNO lumen volume) ranged from 2.7 to 7.4×10^{-4} cc (mean = 5.8×10^{-4} cc). By comparison to the largest third trimester human VNO from previous studies, these preliminary findings suggested that the adult VNO is 40 to 144% larger in length, 319 to 2016% larger in volume, and 315 to 1038% larger in epithelial volume. Results also indicated much variation in VNO size and especially in lumen size, as seen in prenatal humans. Such findings suggest that postnatal growth of the VNO occurs, but the timing of size increase during perinatal and postnatal development is still unclear.

Ethnohistory, genetics, and cancer mortality in Europeans. R.R. SOKAL and M.S. Rosenberg, Ecology & Evolution, SUNY at Stony Brook, NY 11794-5245.

Geographic variation in cancer rates is thought to be the result of two major factors: environmental agents varying spatially and the attributes, genetic or cultural, of the populations inhabiting the areas studied. These attributes in turn result from the history of the populations in question. We have constructed an ethnohistorical database for Europe since 2200 BC., permitting estimates of the ethnic composition of modern European populations. These estimates correlate with genetic distances; we wanted to see whether they also correlate with cancer rates. We employed two datasets of cancer mortalities from 42 types of cancer for the European Economic Community and for Central Europe. We subjected spatial differences in cancer mortalities, genetic, ethnohistorical, and geographic distances to matrix permutation tests to determine the magnitude and significance of their association. Our findings are that distances in cancer mortalities are correlated more with ethnohistorical distances than with genetic distances. The cancer rates may be affected by loci other than the genetic systems available to us, and/or by cultural factors mediated by the ethnohistorical differences. We find it remarkable that patterns of frequently ancient ethnic admixture are still reflected in modern cancer mortalities. Partial correlations with geography suggest local environmental factors affect the mortalities as well.

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Bioarchaeological analysis of human skeletal remains at Utatlan, Guatemala: evidence for human sacrifice. M.C. SOLANO, University at Albany, State University of New York, Albany, NY 12222.

In this analysis, data from skeletons including age, sex, stature, health, and cultural modifications were collected in

order to widen the view of the prehistoric K'ichee'-Maya of Uatatlan. While these data are useful, it is necessary to include archaeological and ethnohistoric data from this site to fully interpret the life and death processes of these individuals. Direct evidence for violence or mechanical dismemberment on the skeletons is lacking, although the age structure, skeletal elements included in the burial, indicators of health including stature, and differences in the quality of grave goods among the burials suggest that many of the individuals did not come from the elite class and were the victims of human sacrifice.

The skeletal collection comes from the Postclassic K'ichee'-Maya capital of Uatatlan, located in the southern highlands of Guatemala. A minimum of 24 individuals were interred under two administrative buildings of the K'ichee' elite at the time of their construction around A.D. 1400. The sample consists mainly of children (n=9), adolescents (n=2), and young adults (n=6), with as few as seven middle-aged adults represented. A bench burial of two complete children was located under one of the buildings, while the other building contained the single burial of a complete adult and a multiple burial of at least 21 individuals. The two children from the smaller burial, and the remains from the multiple burial, including juvenile crania, adolescent and young adult postcrania, and a cremation of at least three adults and a child are interpreted as victims sacrificed in dedication of the construction of these administrative buildings.

When working with skeletal populations, it is useful to include other sources of anthropological data in the reconstruction of life and death processes. In this study, archaeological and ethnohistoric information, in addition to skeletal data, are essential to the conclusion that this skeletal population largely consists of sacrificed individuals. This pattern of differential burial and possible sacrifice at Uatatlan is additionally supported by archaeological and ethnohistoric information from other Maya sites.

Neandertal energetics and foraging efficiency. M. SORENSEN and W.R. LEONARD, University of Florida, Gainesville, FL 32611.

Mechanical interpretations of Neandertal skeletal robusticity suggest that these hominids had extremely high activity levels compared to modern humans. Such activity patterns imply very high energy requirements; yet it has been argued that Neandertals were inefficient foragers (e.g., Trinkaus, 1989; Binford, 1989). The present study addresses this apparent conflict by first estimating energy needs in Neandertals and then evaluating these estimates in the context of energetic and foraging data compiled for contemporary human foragers and nonhuman primates.

Basal metabolic rates (BMR) for Neandertal males and females were predicted based on body weight estimates using regression equations developed by the

WHO (1985). These values were adjusted for increased thermoregulatory costs associated with living in an extremely cold environment. Total daily energy expenditure was then determined assuming "heavy" to "very heavy" daily activity budgets (i.e., 2.0-2.2x BMR).

Estimates of daily energy requirements for Neandertals range from 2900-4400 kcal/day, and are quite high relative to modern human foragers. Comparative foraging data on humans and nonhuman primates suggest that such energy demands would have necessitated foraging efficiencies within the range observed for contemporary hunter-gatherers. Consequently, these results imply that interpretations of Neandertals as having heavy physical activity levels and inefficient foraging strategies are incompatible.

Tooth root morphology and diet in primates. M.A. SPENCER, Duke University Medical Center, Box 3170, Durham, NC 27701.

The roots of primate teeth play a fundamental role in resisting the forces of mastication. However, little is known about how tooth roots may respond to dietary selection pressures. The goal of this study is to examine this response by comparing tooth root morphology between closely related species that consume foods with differing mechanical properties.

Both *Cebus apella* and *Cacajao melanocephalus* regularly process resistant seeds and exhibit associated craniodental adaptations. To identify potential specializations of the tooth roots, maxillary and mandibular canine, premolar and molar tooth roots of these taxa were compared to those of closely related but less specialized species (*Cebus albifrons* and *Pithecia pithecia* respectively). Aspects of root morphology that are plausibly related to load resistance (e.g., root length, mesio-distal and bucco-lingual breadth and projected surface area) were quantified from images of high resolution root replicas (n = 162) using MacMorph 2.0. All dimensions were scaled to cranial size.

Several significant differences in root size and shape distinguish the seed specialists from the less specialized taxa. Both *Cebus apella* and *Cacajao* have relatively large and robust (but not long) tooth roots in those regions of the tooth row known to be used during seed processing: the canines for both groups, and the premolars for *Cebus apella*. Both males and females show this pattern, even though males have relatively larger roots. Furthermore, these taxa also exhibit a reduction in the size and complexity of their third molar roots. This observation is consistent with the hypothesis that specializations for intensive processing on the anterior dentition may lead to a reduction in the ability to apply loads to distal teeth (Spencer & Demes, 1993). In contrast, *Pithecia*, which consumes more leaves than *Cacajao*, has relatively long molar roots.

These results suggest that tooth roots are particularly responsive to differences in the magnitude and frequency of the loads they experience. In this light, it is interesting that all taxa examined here show a reduction in the length and surface area of the tooth roots from M1 through M3. Regardless of its cause, this pattern suggests that these taxa cannot bite as forcefully on their distal molars as on their first molars, contrary to common assumptions based on simple biomechanical models. This inference suggests alternative avenues of specialization from those regularly used in adaptive explanations of craniodental form.